CLAIMS

What is claimed is:

1. A method for dynamically allocating a buffer, the method comprising:
estimating a number of active connections;
adjusting a queue threshold for a queue, wherein the queue threshold is adjusted based, at least in part, on the number of active connections;
computing a drop probability based, at least in part, on the adjusted threshold and a measured queue size;
executing a packet drop routine based upon the drop probability.

2. The method of claim 1 wherein the step of estimating a number of active connections further comprises:
filtering the estimated number of active connections.

3. The method of claim 1 wherein the step of adjusting a queue threshold further comprises:
setting the queue threshold ($T(n)$) according to the relation:

$$T(n) = \max\left\{\frac{P}{2\hat{N}(n)-1}, \gamma\hat{N}(n)\right\},$$

where P is a bandwidth-delay product, $\hat{N}(n)$ is an estimated number of active connections at measurement time n, and γ is a predetermined

parameter that represents a minimum number of packets buffered per connection to avoid a TCP timeout.

4. The method of claim 1 wherein the step of computing a drop probability further comprises:

sampling the queue size $q(n)$ at a time n;

calculating an error signal $e(n)$, at time n according to the relation $e(n) = q(n) - T(n)$, where $T(n)$ is the queue threshold at time n; and

calculating a drop probability $p_d(n)$, at time n according to the relation

$$p_d(n) = \min\left\{ \max\left[p_d(n-1) + \alpha \frac{e(n)}{2T(n)}, 0 \right], \theta \right\},$$

where α is a control gain parameter and θ is a predetermined upper limit on the drop probability.

5. The method of claim 4 wherein the step of calculating an error signal $e(n)$ further comprises:

filtering the error signal $e(n)$ according to the relation: $(1-\beta)\hat{e}(n-1) + \beta e(n)$, where β is a filter gain parameter and $\hat{e}(n-1)$ is the filtered error signal at time $n-1$.

6. The method of claim 1 wherein the step of executing a packet drop routine further comprises:

dropping packets according to a random number generator drop scheme.

7. The method of claim 1 wherein the step of executing a packet drop routine further comprises:
dropping packets according to an inter-drop interval count routine.

8. An apparatus for dynamically allocating a buffer, the apparatus comprising:
an active connection estimator for estimating a number of active connections;
a queue threshold adjuster for adjusting a queue threshold for a queue, wherein the queue threshold is adjusted based, at least in part, on the number of active connections;
a drop probability calculator for computing a drop probability based, at least in part, on the adjusted threshold and a sampled queue size; and
a packet drop module for executing a packet drop routine based upon the drop probability.

9. The apparatus of claim 8 wherein the active connection estimator further comprises:
a filter for filtering the estimated number of active connections.

10. The apparatus of claim 8 wherein the queue threshold adjuster further comprises:
a module for setting the queue threshold ($T(n)$) according to the relation:

$$T(n) = \max\left\{\frac{P}{2\hat{N}(n)-1}, \gamma\hat{N}(n)\right\},$$

where P is a bandwidth-delay product, $\hat{N}(n)$ is an estimated number of active connections at measurement time n, and γ is a predetermined parameter that represents a minimum number of packets buffered per connection to avoid a TCP timeout.

11. The apparatus of claim 8 wherein the drop probability calculator further comprises:

a queue size sampler for sampling the queue size $q(n)$ at a time n;

an error signal calculator for calculating an error signal $e(n)$, at time n according to the relation $e(n) = q(n) - T(n)$, where $T(n)$ is the queue threshold at time n; and

a module for calculating a drop probability $p_d(n)$, at time n according to the relation $p_d(n) = \min\left\{\max\left[p_d(n-1) + \alpha\frac{e(n)}{2T(n)}, 0\right], \theta\right\}$, where α is a control gain parameter and θ is a predetermined upper limit on the drop probability.

12. The apparatus of claim 11 wherein the error signal calculator further comprises:

a filter for filtering the error signal $e(n)$ according to the relation: $(1-\beta)\hat{e}(n-1) + \beta e(n)$, where β is a

filter gain parameter and $\hat{e}(n-1)$ is the filtered error signal at time $n-1$.

13. The apparatus of claim 8 wherein the packet drop module further comprises:

a random number generator drop scheme module.

14. The apparatus of claim 8 wherein the packet drop module further comprises:

an inter-drop interval count routine module.

15. An article of manufacture for dynamically allocating a buffer, the article of manufacture comprising:

at least one processor readable carrier; and

instructions carried on the at least one carrier;

wherein the instructions are configured to be readable from the at least one carrier by at least one processor and thereby cause the at least one processor to operate so as to:

estimate a number of active connections;

adjust a queue threshold for a queue, wherein the queue threshold is adjusted based, at least in part, on the number of active connections;

compute a drop probability based, at least in part, on the adjusted threshold and a measured queue size;

execute a packet drop routine based upon the drop probability.

16. A signal embodied in a carrier wave and representing sequences of instructions which, when executed by at

least one processor, cause the at least one processor to dynamically allocate a buffer by performing the steps of:

estimating a number of active connections;

adjusting a queue threshold for a queue, wherein the queue threshold is adjusted based, at least in part, on the number of active connections;

computing a drop probability based, at least in part, on the adjusted threshold and a measured queue size;

executing a packet drop routine based upon the drop probability.